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Effect of Addition of Moringa Leaves (*Moringa oleifera*) on Chemical Characteristics and Nutritional Value of Chicken Sausage Chips

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ABSTRACT

The leading cause of malnutrition in NTT province is the lack of balanced nutrition, one of which is macronutrients such as carbohydrates, proteins, and fats. So there is a need for innovation from livestock products rich in readily available animal protein, one of which is chicken. Utilization of the results of heating technology Moringa leaf flour which is rich in micro and macronutrients is available in the province of NTT, so that it can provide processed products in the form of chicken sausage chips with the addition of Moringa leaf flour. This study aims to determine the effect of adding Moringa leaf flour P0, P1, P2, and P3 on chicken sausage chips' chemical characteristics and nutritional value. Each treatment P0 Moringa leaf flour (0%), P1 Moringa leaf flour (1%), P2 Moringa leaf flour (2%), P3 Moringa leaf flour (3%). The experimental method used is a simple, completely randomized design (CRD) with four treatments and four replications. Analysis of the ANOVA (Analysis of Variance) data and Duncan's further test, while the nutritional value content was calculated according to BPOM regulation NO 19 of 2019 concerning Nutrition Label Reference. The results showed that the addition of Moringa leaf flour had a significant effect on the chemical characteristics of $P<0.05$. According to the National Food and Drug Administration Agency (BPOM), for appropriate nutritional content, information on the nutritional value of chicken sausage chips.

Keywords: chips, chicken, sausage, chemistry, nutrition, and moringa

INTRODUCTION

Undernutrition is a significant factor in the occurrence of malnutrition and stunting in children, which can cause the level of intelligence to be not optimal; children are susceptible to disease, disturbed height growth, and can affect future economic movements. Malnutrition occurs due to nutritional deficiencies that can lead to death. The problem of malnutrition and stunting in Indonesia is not only caused by poverty; data from the National Team for the Acceleration of Poverty Reduction (TNP2K, 2017) shows that non-poor families at 40% of the level of social welfare also experience stunting. The priority districts/cities for stunting interventions included in the 100 most districts/cities are NTT Province (TNP2K, 2017). Malnutrition and stunting are caused by a lack of balanced nutrition both macro and micronutrients such as energy, protein, water content, carbohydrates, fat, calcium, phosphorus, magnesium, iron, zinc, and copper (Abbas et al., 2018). Based on several causes of malnutrition and stunting, processed livestock products need to be innovated for food from the potential of natural resources available in the malnutrition and stunting area.

Chicken is one livestock that is very easy to obtain and rich in animal protein. Chicken meat can be extended its shelf life by processing and one of them is by using heating technology such as chicken sausage. Chicken Sausage is a product of raw chicken meat mashed with or without other additives or permitted additives. It is inserted into sausage casings with or without a heating process. Sausage casings can be made from natural materials or artificial materials that can be eaten or cannot be eaten (SNI, 2015). In general, chicken sausages have been innovated in frozen food and sterilized products by food producers. Still, it is not yet practically accepted by areas not covered by distribution from the producer market because storage and handling must be at a specific temperature. Preparations such as chips can be an option for practical and healthy chicken meat preparations with or without the use of food additives.

The use of heating technology in the manufacture of chicken sausage chips can affect the nutritional content; according to Aasma et al. (2015), cooking chicken sausage can produce a total fat content that is different from the fresh ingredients used. Moringa leaf flour in making chicken sausage chips needs to be used. Moringa leaves are rich in nutrients both in a fresh and dried form such as energy, protein, water content,

carbohydrates, fat, calcium, phosphorus, magnesium, iron, zinc, and copper (Abbas et al., 2018), in addition to the addition of Moringa to snacks can add nutritional value such as energy and minerals (Gopalakrishnan et al., 2016). The high nutritional content of Moringa leaves can be used in making sausage chips with the addition of Moringa leaf flour. Based on these considerations, research was conducted on "Chemical and Organoleptic Characteristics of Chicken Sausage Chips with the Addition of Moringa Leaf Flour." This study aimed to determine the effect of adding Moringa leaf flour to 3% of the total ingredients on chicken sausage chips' chemical characteristics and nutritional value.

MATERIALS AND METHODS

Research Methods

The material used in this study was chicken meat with ages ranging from 30-33 days. The chicken part used was chicken breast which was grinded to a size of 10 mm, then the cooling process was carried out. The casing used comes from a collagen sausage casing with a transparent color. The casing used was 18.45 mm in size. Moringa leaf flour was made from CV Anugrah Moringa Timor where the Moringa leaves are from areas in the province of NTT. The flour used in this study was tapioca flour with the trademark sago tani, medium protein flour with the trademark blue triangle, corn starch with the trademark Haan Maizena. Chicken sausage filling material used in the manufacture of chicken sausage made from frozen chicken skin made into skin emulsion. The chicken sausage seasoning used consists of garlic, white pepper, nutmeg, ginger, salt, sugar, chicken stock, and ginger.

Research Procedure

Process of making skin emulsion

Chicken skin cleaned of fine feathers was frozen in a refrigerator with a maximum temperature of 0^0C. The frozen chicken skin was then put in a food processor and milled until a skin emulsion was formed.

Making Sausage Chips with the Addition of Moringa Leaf Flour

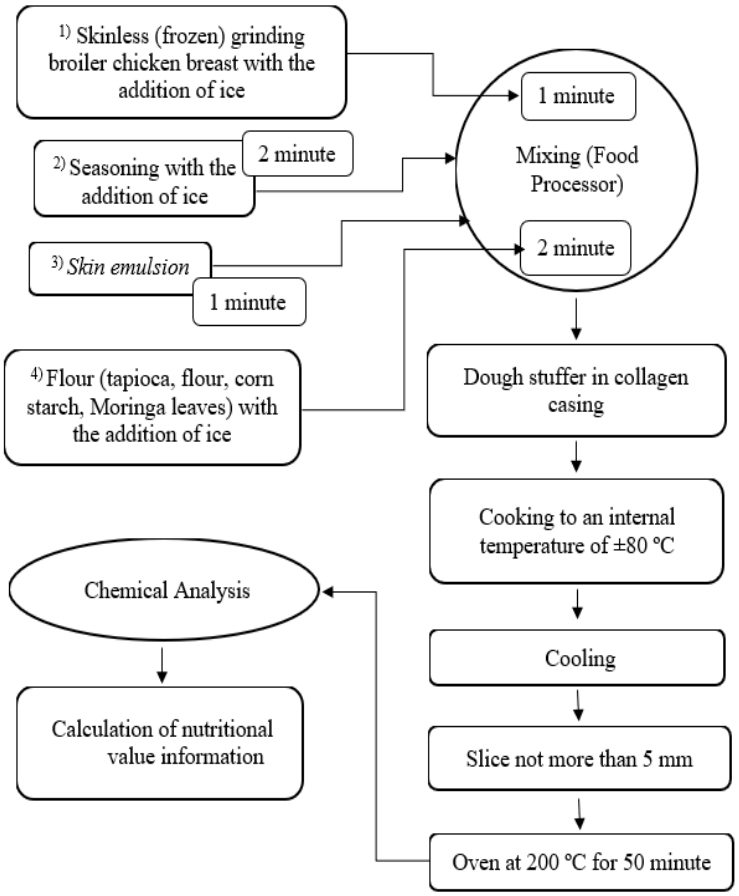

Figure 1. Process of making Sausage Chips with the Addition of Moringa Leaf Flour

This was experimental research carried out by using Completely Randomized Design (CRD) with the addition of Moringa leaf flour with four different treatments with the formulations available in table 1 Chicken sausage chips formulation as follows:

Table 1. Chicken sausage chips formulation

Chicken sausage chips formulation				
Ingredients Name	P0	P1	P2	P3
	(%)			
Chicken breast	60.00	60.00	60.00	60.00
Ice	20.60	20.60	20.60	20.60
Chicken skin as emulsion	7.30	7.30	7.30	7.30
Moringa leaf flour	0.00	1.00	2.00	3.00
Tapioca flour	9.00	8.00	7.00	6.00
Cornstarch	0.60	0.60	0.60	0.60
Flour	0.40	0.40	0.40	0.40
Salt	0.80	0.80	0.80	0.80
Powdered chicken broth	0.40	0.40	0.40	0.40
Sugar	0.20	0.20	0.20	0.20
Ginger powder	0.20	0.20	0.20	0.20
White pepper	0.20	0.20	0.20	0.20
Garlic	0.20	0.20	0.20	0.20
Nutmeg powder	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00

Research variables

The variables measured in this study were chemical characteristics in water content, ash content, protein content, and fat content. The calculation in testing the chemical characteristics refers to the writing of the National Standardization Agency (BSN, 2015) with the formula for water content (%) : (w2-w1)/(w2-w) x 100%, where w is the weight of an empty cup (g), w1: weight of cup filled with sample (g), w2: weight of cup with dried sample (g), while the calculation in testing ash content of ash content (%) : (w-w1)/w2 x 100%, where w: weight of cup + ash (g), w1: weight of empty cup (g), w2: weight of sample cup (g).

Calculation of protein content by looking for the percentage of nitrogen which then calculates the protein content of the formula protein content (%): %Nitrogen x 6.25 where the percentage of Nitrogen was obtained from the following formula Nitrogen (%): (ml HCl sample-ml blank HCl) x N HCl x 14)/(sample weight (g) x 1000) x 100%, where a: ml titer sample, b: ml titer blank. The formula for fat content, fat content (%) : (w3-w2)/w1 x 100%, where w1 is the weight of the cup and sample, w2 is the weight of the empty cup, w3 is the weight of the cup + cooled fat. These chemical characteristics are needed to calculate the percentage of nutritional adequacy figures. According to applicable regulations, the percentage of nutritional adequacy figures must inform the sodium and sugar content if the ingredients use sugar on food labels as nutritional values (BPOM, 2019).

The data obtained in this study were statistically analyzed with data from chemical test results processed by variance ANOVA (Analysis of Variance) using the SPSS 25.0 for windows program. At the same time, information on nutritional values refers to BPOM regulations. If the results of the chemical analysis show a significant or very significant difference, further analysis will be carried out using Duncan's test.

RESULT AND DISCUSSION

The chemical characteristics of chicken sausage chips have not been regulated by SNI or BPOM regulations. However, in BPOM RI Regulation No. 34 of 2019 concerning Food Categories, which are closer to the chicken sausage chip product, Food Category Number

08.2.2 so the author used food category No. 08.2.2, namely lung chips. In the calculation of nutritional value information, Chicken sausage chips referred to BPOM Regulation No. 22 of 2019, while the reference standard for chemical characteristics used the Lung cracker SNI standard written on the National Standardization Agency (BSN, 2016). The test results of chemical characteristics such as water content, ash content, protein content, and fat content in chicken sausage chips with Moringa leaf flour can be seen in Table 2. The results of the chemical characteristics test of chicken sausage chips.

Table 2. Chemical characteristics of chicken sausage chips

Parameter (%)	Addition of Moringa leaf flour			
	P0	P1	P2	P3
Water	3.05±0.043[a]	3.89±0.073[b]	4.29±0.026[c]	6.40±0.053[d]
Ash	5.02±0.103[a]	5.61±0.110[b]	6.02±0.059[d]	5.77±0.045[c]
Protein	45.20±0.355[a]	43.85±0.173[b]	44.52±0.263[c]	46.30±0.483[d]
Fat	14.37±0.150[a]	14.75±0.100[b]	14.65±0.057[b]	15.50±0.081[c]

Note: different superscripts on the same line show a very significant difference (P<0.05)

Water Content

The results of the water content test in Table 2 show that each treatment with the addition of Moringa leaf flour was significantly different, P<0.05, which indicates the effect of adding Moringa leaf flour to the water content of chicken sausage chips. The average value of each treatment increased, namely P0 of 3.05, P1 of 3.89, P2 of 4.29, and P3 of 6.40. The higher the addition of Moringa leaf flour, the higher the water content of the chicken sausage chips. The increase in the water content of chicken sausage chips is thought to be due to the water content in Moringa leaf flour which is still present at 5.02%.

The lower the water content of the chicken sausage chips, the crispier the texture of the chips will be. The high and low water content value can be influenced by cooking temperature (Surbakti et al., 2016), drying time, and storage time (Asgar et al., 2010). The value of water content can also affect the appearance, texture, and taste (Palandeng et al., 2016) for the level of the crispness of chips can also be determined by the starch content (Asgar et al., 2010), the high water content can facilitate microorganisms such as molds, yeasts, and bacteria pathogens multiply (Iskandar et al., 2018). According to the SNI standard for lung crackers, the moisture content has a maximum limit of 4, so for the addition of Moringa leaf flour, the SNI standards are P0 and P1, while P2 and P3 do not meet the SNI standard for lung chips.

Ash Content

The results of testing the ash content for each treatment were significantly different P <0.05, so there was an effect of adding Moringa leaf flour to the ash content of chicken sausage. Ash content results from weighing combustion residues at a high temperature of 500-600 °C in the form of organic substances such as calcium, potassium, sodium, iron, manganese, iodine and magnesium (Rosiani et al., 2015). In Moringa leaf flour from CV Anugerah moringa Timor, the analysis result is 9.56% ash content, so the more added Moringa leaf flour, the higher the ash content produced. The average value of ash content for each treatment was 5.02% (P1), 5.61% (P2), 6.02% (P3), 5.77% (P3).

Each addition of Moringa leaf flour increased the average ash content of chicken sausage chips, except in P3 with 3% Moringa leaf flour. This can be caused in the P3 treatment the ashing process has not been maximized due to the high water content in P3, so the mineral content in chicken sausage chips is lower than P2 but higher than P1 and P0. In each treatment, the ash content results did not meet the SNI requirements for lung crackers written in the National Standardization Agency (BSN, 1996).

Protein Content

The protein content of chicken sausage chips with the addition of Moringa leaf flour for each treatment was significantly different P<0.05. These results indicate the effect of adding Moringa leaf flour to the manufacture of chicken sausage chips. The protein content test in chicken sausage chips is shown in table 2. The protein content in Moringa leaf flour from CV Anugerah Moringa Timor was 24.5%. The higher the addition of Moringa leaf flour, the higher the protein content in chicken sausage chips, but the statistical analysis results showed the highest

average was in treatment P3 and P0, while the lowest average value was in treatment P1 and P2.

The denaturation process can cause an increase in protein levels at P0 and P3. The denaturation process is related to the water content value. The increase in water loss or the lower the water content value, the higher the protein content of chicken sausage chips (Novia et al., 2011). This paper is different from the analysis results in the P3 treatment, where the mean value of the P3 water content is higher and parallels the increase in the higher protein content.

It is suspected that adding 3% Moringa leaf flour increases the protein content, whereas the protein content of Moringa leaf flour is 24.5%. The increase in the average value in each treatment with the addition of Moringa leaf flour met the SNI requirements for lung crackers protein content, which was more than 15%. Food quality can be seen in the protein value content, where the higher the protein content, the better the quality of the product (Suhartini et al., 2018). According to Lonnie et al. (2018), protein has an important role in preventing malnutrition and promoting healthy muscle aging.

Fat Content

Fats are organic compounds found in nature and are insoluble in water. The results of statistical analysis of fat content in chicken sausage chips averaged between 14.37%-15.50%, shown in Table 2. The average value increased along with the addition of Moringa leaf flour in making chicken sausage chips. The increase in fat content can be influenced by the fat content of Moringa leaf flour of 7.08%, so adding Moringa leaf flour can increase the fat content of chicken sausage chips. The increase in fat content in chicken sausage chips for each treatment was significantly different $P<0.05$ except for P1 and P2 $P>0.05$. These results can be interpreted as adding Moringa leaf flour to the fat content of chicken sausage chips, although at P1 and P2, there is no significant effect with a lower P2 value. The low-fat content can be caused by the presence of fatty acids extracted out during steaming (Palandeng et al., 2016) due to the instability of the emulsion (Juhariah, et al., 2019).

Calculation of Nutritional Value Information

Calculation of nutritional value information refers to the nutritional adequacy rate that has been regulated in the regulation of the ministry of health. Chicken sausage chips are a new product innovation made from chicken meat as the main ingredient. New processed products such as chicken sausage chips do not yet have certain rules or criteria in the food category. The food category is adjusted to the raw materials and processing processes close to food criteria. Food for general conditions regulated by the Ministry of Health is summarized in the BPOM regulation regarding nutritional label references.

The reference for nutrition labels is used in calculating the percentage of nutritional adequacy figures using BPOM regulation no. 9 of 2016 concerning Nutrition Label Reference (ALG). According to the Food and Drug Supervisory Agency's writings, the percentage of the nutritional adequacy rate is used to determine the adequacy of energy, protein, fat, carbohydrates, fiber, vitamins, water, and minerals, according to the writings of the Food and Drug Supervisory Agency (BPOM, 2019). In the writing of BPOM regulation No. 16 of 2020, the nutritional adequacy figures in the nutritional value information format are the percentage of nutritional adequacy numbers when consumed according to the serving size. The serving size is the result of the number of nutrients in metric units (g, mg, ml); for processed food types of chicken sausage chips, the serving dose is set at 20 g so that to determine the nutritional value per product serving dose, it is necessary to calculate according to the regulations of the Drug and Drug Supervisory Agency. Food nutritional value information is as follows: 20g/100g x nutritional value of the product according to the analysis results (BPOM, 2020). According to the writings of the Ministry of Health, the total energy value is obtained from values of carbohydrates, fats, and proteins that already exist (Kemenkes, 2017).

The ALG value for general conditions for energy nutrients is 2150 kcal, protein is 60 grams, total fat is 67 grams, total carbohydrates are 325 grams, while sodium is 1500 milligrams according to the regulations of the Food and Drug Supervisory Agency (BPOM, 2019). The ALG value can calculate the percentage of AKG (Nutrition Adequacy Number) with the following formula: (nutrient value per serving)/(nutrient ALG) x 100% according to calculations from the Food and Drug Supervisory Agency regulations (BPOM, 2020). Information on nutritional value is a list of nutritional and non-nutritive content of processed food in a standardized format found on the label of processed food packaging sold, which is written in the Food and Drug Supervisory Agency (BPOM, 2019). Table 3 Information on

the nutritional value of chicken sausage chips for each treatment (P0, P1, P2, and P3). Calculations in the nutritional value information use the values listed on the results of testing chicken sausage chips in the laboratory without using the average value.

Table 3. Information on the Nutritional Value of Chicken Sausage Chips.

Nutrients	Total Nutritional Value of Chicken Sausage chips				% AKG per serving			
	P0	P1	P2	P3	P0	P1	P2	P3
Total energy	90 kcal	90 kcal	90 kcal	90 kcal				
Total fat	3 g	3 g	3 g	3 g	4	4	4	5
Protein	9 g	9 g	9 g	9 g	15	15	15	15
Total Carbohydrate	6 g	6 g	6 g	5 g	2	2	2	2
Sugar	1 g	0 g	0 g	0 g				
Natrium	270 mg	330 mg	300 mg	310 mg	18	22	20	21

The data explained that each treatment with the addition of Moringa leaf flour each met daily energy of 90 kcal per serving, while the daily fat requirement was 4-5%. Chicken sausage chips for each treatment can meet the protein requirement of 15% per serving, while for total carbohydrates it is 2% per serving. Value The nutritional adequacy rate on the nutritional value information can be included in the food label as information on nutritional value.

CONCLUSION

From the results of this study, it can be concluded that the addition of Moringa leaf flour to chicken sausage chips had a significant effect of $P<0.05$ on water content, ash content, protein, and fat. Calculation of Nutritional Value Information according to BPOM Perka No. 9 of 2016. It is recommended that this research be continued by testing the shelf life of the product and testing hedonic quality as well as microbiological testing to determine the quality of chicken sausage chips so that it can increase knowledge for researchers and the public so that they can be used as commercial food innovations for snacks from ready-to-eat livestock products and easy to adjust the time and place.

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